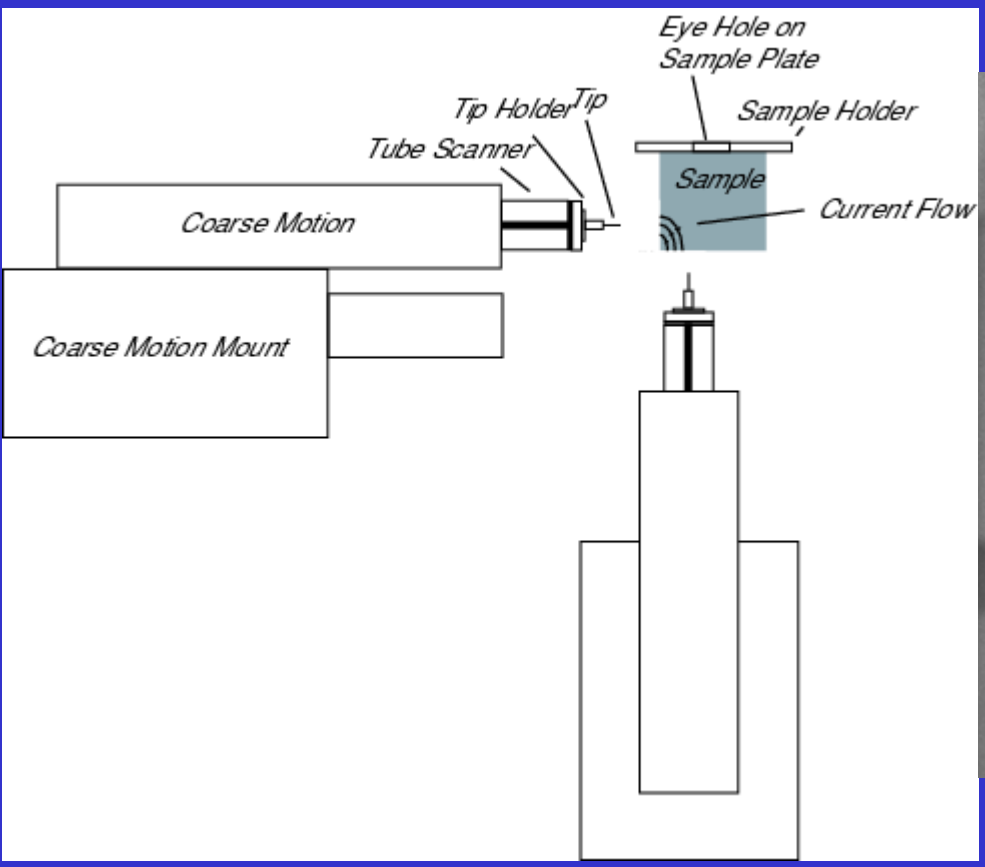
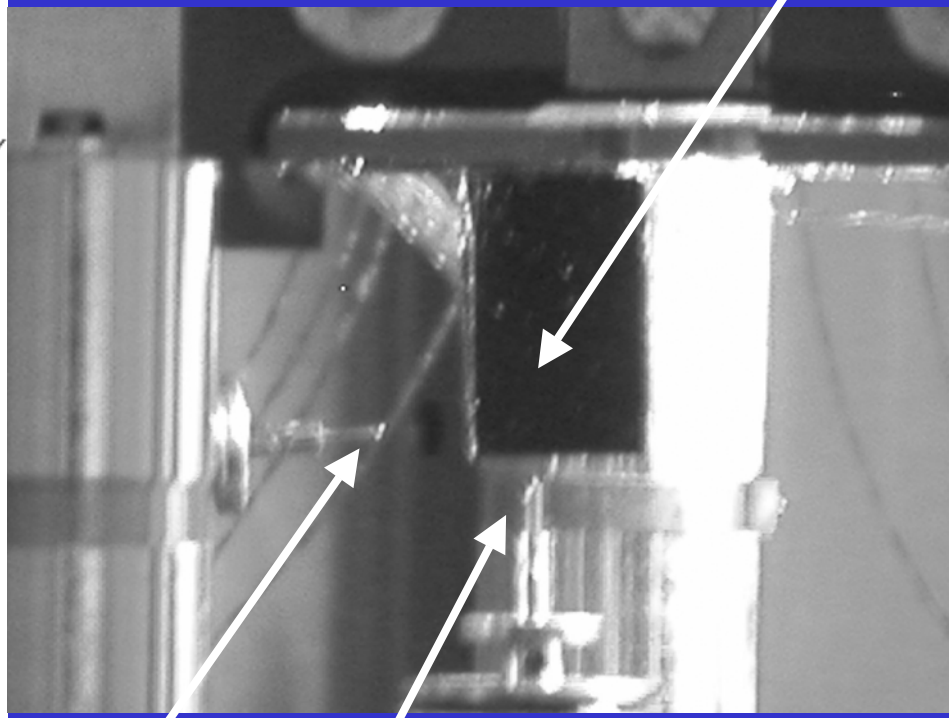
Spin-Polarized Field-Effect Transistor (Spin-FET)

Paul M. Thibado

MRI:0215872



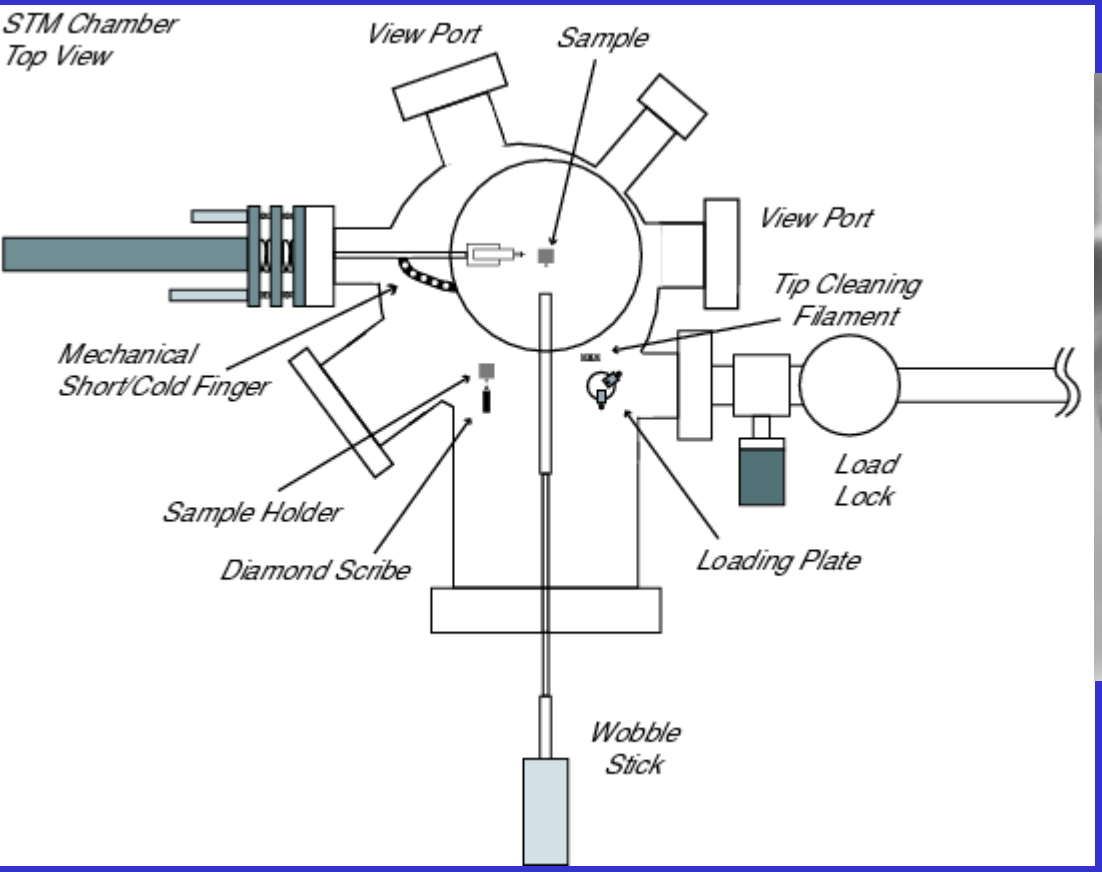


The NSF-MRI award entitled Development of a Spin-Polarized Field-Effect Transistor (Spin-FET) allowed us to assemble a revolutionary device for studying nanoscale electrical transport properties. At the core of this system are two STM tips that image a single sample. The two tips approach the sample from perpendicular directions. The left side of the slide above shows a schematic diagram of the two tips and the sample. The right side of the slide shows a photograph of the two tips and the sample. With this novel geometry you can see how easy it is for the two tips to be brought within a few nanometers of each other and near the corner of the sample. Notice how this feat is not physically possible when the two tips are imaging the same surface. With this system we can inject electrons with a particular spin orientation using one tip and then pull them back out a few nanometers later using the second tip. During their trip through the sample we can have them pass through epitaxially grown thin films, and thus determine the impact of the film on the spin orientation. Naturally, this is a three terminal device with tip 1 as the source, tip 2 as the drain, and the sample forming the channel. With spin-polarized metal tips, this system forms the first spin-FET.

Spin-Polarized Field-Effect Transistor (Spin-FET)

Paul M. Thibado

MRI:0215872



Manipulator/support for second tip

Two tips & sample

The NSF-MRI award entitled Development of a Spin-Polarized Field-Effect Transistor (Spin-FET) allowed us to assemble a revolutionary device for studying nanoscale electrical transport properties. The left side of the slide above shows a schematic diagram of the entire system. The system is under ultra-high vacuum and can be cooled with liquid nitrogen or helium. We can introduce fresh samples through a load lock, then degas, scribe and cleave them in vacuum. We can also introduce fresh STM tips through the load lock and e-beam clean them in vacuum. The right side of the slide above shows a photograph of the manipulator that supports the right-pointing STM tip. To achieve this two-tip low-temperature STM we had to make many custom modifications to the commercial Omicron low-temperature STM. We are in the process of writing a paper for publication in Review of Scientific Instruments where we provide the complete details necessary for other groups to build this system.

Spin-Polarized Field-Effect Transistor (Spin-FET)

Paul M. Thibado

MRI:0215872

Girl Scout Troop #87
Fayetteville, Arkansas

Earns Science “Try-It” Patch

Girls Scout troop 87, Fayetteville, Arkansas visits Prof. Thibado's research laboratory. The purpose was to learn some of the wonders of science and learn about the critical need for women to become physicists.

This event was very successful – just look at their faces. Girl Scout troops represent a large nationwide pool of young girls very eager to learn new things and naturally chaperoned by their mothers. Thus, they are an easy group to tap into and there are hundreds in Northwest Arkansas. These girls also received a science "try-it" patch for there activities.

The days events were simple and fun. We gave them a snack. They watched some liquid nitrogen demonstrations. We had them perform four different hands experiments [(1) build an atomic model to take home, (2) make a marshmallow expand in size by removing the air around it, (3) spot weld two metals strips together, and (4) identify an image under a high-powered optical the microscope]. Then, we took them to a classroom and had them participate (using individual transmitters) in a question and answer session. We showed them statistics on how few women become physicists and how there is a critical need at the national level for them. We all agreed that science is fun and it's cool to become a scientist. Finally, we empowered them with dialog to combat peer-pressure and stay on a science track as they move into the difficult middle school years ahead. The girls were so moved by the discussion that several of them (including some mothers) are certain that this is what they will pursue for their career.